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Global Workforce Trends in Health Informatics & Information Management

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Abstract

In a data driven environment, healthcare has seen ongoing digital transformation to meet both clinical and business needs. But, have the educational and functional requirements of the health informatics and information management (HIIM) workforce also adapted? This study examined the current employment opportunities in HIIM globally. Using 11 keywords generated from a literature review, postings on the job advertisement website Indeed™ for all available countries were analyzed. The results show that job postings tend to fall within 4 discrete categories: 1) health information technology; 2) health research; 3) health leadership and project management; and 4) health compliance. Data indicated a higher prevalence for certain areas by country. The findings from this study can inform HIIM educational providers about future skill requirements.

Keywords:
Career Choice, Medical Informatics, Cluster Analysis

Introduction

One of the primary reasons to seek higher education is to prepare for a career with interesting work that pays a living wage. In an attempt to determine which skills and competencies are currently most desired by employers, a group of health informatics and information management (HIIM) educators undertook a qualitative analysis of health information management and health informatics-related job postings from Indeed.com.

In health informatics, many of the educational competencies required for training programs have been determined primarily by educators or professionals who have been in the field for years. While these stakeholders certainly have experience and a role to play, they may not be the main employers. Worse, these people are often not aware of emerging trends or knowledgeable about all of the new skills needed by the workforce. This is more of a concern for fields such as health informatics and information management, where significant technical change is occurring, as well as for any current job where machine learning has the potential to be employed at less expense than the human workers.

The purpose of this study is to describe the characteristics of careers related to health informatics and information management, as well as explain the geographical commonalities and differences in the skills and knowledge required for employment using international job posting data.

Background

With the growth of Information Technology (IT) and the advent of big data, the healthcare industry is dynamically adapting to the current need to harness big data for improving healthcare performance and decision-making [1]. The adoption of electronic health records (EHRs), has been a central focus in United States in the past few years with providers all around the world continuing to adapt to technology at a rapid pace. Several studies from Canada, Iran, Nigeria and Saudi Arabia have identified obstacles in IT implementation relating to a health information management workforce shortage [2-4]. A specific study by the Canadian Health Information Management Association in 2014 identified workers needed in the areas of standards, data quality and management, information governance, change and project management [5].

Globally, EHR adoption rates have been influenced by the availability of funding, governance, standardization, interoperability, and communication [6]. Recently, Black Book Research conducted a poll surveying 7,459 physicians, health administrators, technology managers and clinical leaders in both inpatient and ambulatory settings across 23 countries to identify gaps, challenges and successes in healthcare IT adoption and connectivity. Included in those surveyed were five countries with evidence of nearly 100% EHR adoption rates: Norway, Netherlands, United Kingdom, New Zealand, and Australia, as well as five countries with nearly 75% provider adoption rates: Germany, France, Canada, Switzerland, and Singapore. Regions from Europe, Middle East, and South Asia showed a drift from siloed EHRs to more integrated healthcare IT systems. With the increased adoption and use of the digital technology, new roles have emerged in e-health to support the implementation and the administration of the operations and maintenance of the technological infrastructure [7]. To augment these roles there is a need for enhancing the skillset to strengthen the health informatics and information management workforce. The International Federation of Health Information Management (IFHIMA) documented the Global Health Information Curricula Competencies in their comprehensive 2015 report for Health Informatics, Health Information Management and Health Information and Communication Technologies. The premise was that even though universities strive to provide relevant curricula to students, it may not represent the actual needs of a career-ready graduate.

Furthermore, with the adaptation of new technology, growing consumer engagement and changes in legislation and regulatory requirements there are changes to the healthcare workforce [8]. The workforce has seen a trend of new career opportunities emerging in the areas of data analytics, data governance, privacy and security and interoperability. Our objective through this study is to highlight trends in health informatics and information management careers that are most

prevalent globally and examine if there are differences across countries using data acquired from the job site Indeed.com.

Methods

Keyword Derivation

The research team generated a list of 11 categories to search for online job postings based on recent literature, suggesting trends of increased growth in these areas: Information Technology, Classification and Clinical Documentation Improvement, Consumer Engagement, Leadership, Research, Information Governance, Project Management, Health Informatics, Information Technology, Compliance, and Health Data Analysis. These categories were used as the keywords when searching for job postings.

Query of International Job Postings

In September 2018, job postings from 64 countries were queried from Indeed.com. Queries were generated for the 11 job categories described earlier. In addition to the job titles, the word "health" was used as a qualifier to exclude job postings not related to healthcare. The job title, date of posting, location, company, and a URL to the full job description was obtained using the Indeed.com API. The job description and requirements were derived from the text located on the URL from each job posting. Using the *urllib.request* python library only valid URLs were included in the analysis, as determined by an HTTP status code of 200 (i.e., indicating a successfully working URL). The *BeautifulSoup* Python library was used to query the contents of the HTML files. All of the content located on the specified URL landing page was used as the original resource text. The HTML files were then prepared to remove duplicate records and aberrant text.

Analysis of Text

The job posting URL landing page text was prepared using the R statistical software package. The *tm* R package was used to tokenize the text which was transformed to lowercase, punctuation was removed, the resulting white space was stripped, common English words (i.e., stopwords) were removed from the text, and word stems were discarded. The text corpus was normalized using Term Frequency-Inverse Document Frequency (TF-IDF) to emphasize terms that appear multiple times in a single job posting while decreasing the importance of terms that appear many times across all job postings. Sparse terms amongst the jobs posted were also removed.

The corpus of text was evaluated to cluster similar job postings with K-Means clustering using Euclidean distances. Cluster tags were generated based on the cluster centers to determine which postings belonged to particular clusters. The optimal number of clusters was determined using the average silhouette approach to obtain the number of clusters that yields the highest quality of separation. The clusters were characterized by the terms at cluster centers that had the highest and lowest means to better understand the differentiating features of the clusters.

To compare the frequency of job posting categories by country, a heatmap was used to compare the frequency of postings across all countries and the 11 job categories. Additionally, the relative differences of needed skills and knowledge emphasized across job categories in each country was depicted in a stacked bar plot based on the proportion of job postings in each country for a particular cluster across each of the 11 job categories.

Results

The results show that by using an automated method of clustering, job postings tend to fall within 4 discrete categories. Additionally, there are differences in the frequency of job postings related to the 11 key categories when comparing countries.

Table 1 - Characteristics of Clusters

Cluster	WSS*	Size	Key Terms
1	83.1	7350	data, engine, software, test, analyst, design, security, system, technology, solution
2	63.3	4894	clinic, patient, medic, care, hospitals, research, studies, healthcare, staff, site
3	194.7	18695	sale, market, custom, research, client, business, project, account, service, product
4	87.2	7039	safety, engine, site, maintenance, equip, project, regulatory, environment, manufacturer, compliance

*WSS= Within-Sum Squares

In Table 1, the clusters are distinguished by key characteristics. The total within-cluster sum of squares (WSS) was 428.3 and the between-cluster sum of squares was 20.1 resulting in an internal cohesion of 0.045. This demonstrates that there was a large variance of job postings within clusters and moderate to small separation of job postings between clusters (Figure 1). Cluster 1 is the 2nd largest and is distinguished by containing jobs postings related to more technical skills and knowledge related to data, software, design, and technology. Custer 2 was the smallest in size and the job postings within the cluster were the most highly related. Job postings in Cluster 2 were more clinically focused, as shown by the prevalence of terms related to clinic, patient, medicine, and care. Cluster 3 had the largest number of job postings and the highest degree of variation. The most common terms to occur in job postings in Cluster 3 included sale, market, research, client, business, and terms more related to healthcare sales, marketing, and project management. Lastly, job postings in Cluster 4 included terms related to compliance such as safety, regulatory, and maintenance.

The number of job postings in each cluster across the 11 categories shows that the majority of the jobs in Cluster 1 are related to health information technology; in Cluster 2 to health research; in Cluster 3 to health leadership and health project management, and in Cluster 4 to health compliance (Figure 2).

When comparing the job postings by country, the proportion of postings are predominantly assigned to Cluster 3 (Figure 3). When comparing the frequency of job postings by category for each country (Figure 4), the most common category is Health Project Management followed by Health Leadership, Health Information Technology, and Health Research. The least common categories include Health Informatics, Health Consumer Engagement, and Clinical Documentation Improvement. Interestingly, there are categories in the United States which occur frequently that do not occur often in other countries. These include Health Consumer Engagement, and Clinical Documentation Improvement. Additionally, Health Data Analysis is frequent in the United Kingdom, Canada, Australia, and India, but is less frequent in the United States.

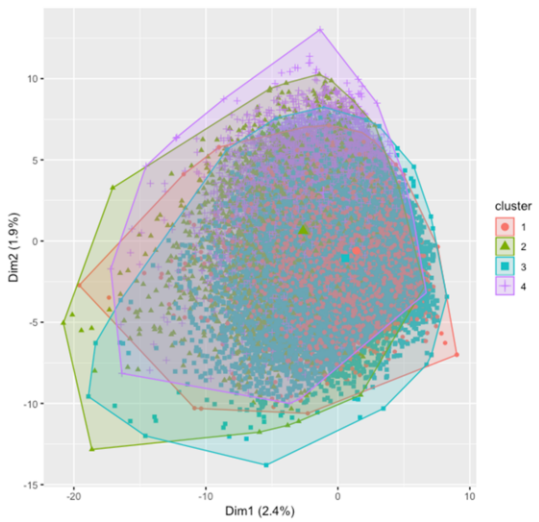

Figure 1 - K-Means Clustering of Job Postings

Discussion

This study demonstrated that jobs in health informatics and information management can be distinguished by key characteristics and there are differences across countries in the prevalence of jobs postings by these characteristics. In general, this study showed that job listings can be categorized into 4 distinct groups based on required skills and knowledge: technology focused; clinically focused; compliance focused; and sales/marketing/management focused. This approach is different than previously published initiatives to define needed competencies for the health informatics and information management workforce by the International Medical Informatics Association (IMIA), the Health Information Management and Systems Society (HIMSS) in cooperation with the European Union, the U.S., Australia, and Canada [5, 9-14]. The mapping of these can be found in Table 2.

	1	2	3	4
Clinical Documentation Improvement	100	627	236	138
Health Compliance	442	541	2249	2220
Health Consumer Engagement	110	64	763	30
Health Data Analysis	1119	184	1291	344
Health Informatics	249	268	155	11
Health Information Governance	325	232	674	135
Health Information Technology	2064	606	2651	460
Health Leadership	737	786	3941	1432
Health Project Management	1281	357	3538	1869
Health Research	923	1229	3197	400

Figure 2 - Heatmap of Job Postings Within Each Cluster Across Job Categories

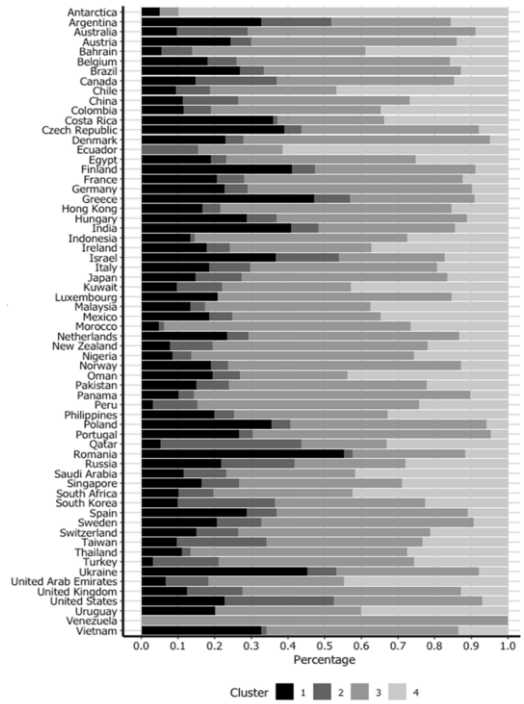

Figure 3 - Proportion of Job Postings in Each Cluster for Each Country

Global Comparison

In 2010, IMIA made recommendations for biomedical and health informatics education [9]. Interestingly, the IMIA domain area of informatics/computer science, mathematics, and biometry is closely related to technology cluster of this study, with the domain of medicine, health and biosciences, and health system organization related to clinical cluster. The third domain of the IMIA recommendations relates to foundational informatics knowledge and skills.

There has also been a cooperative effort between the EU and the U.S. to develop a comprehensive list of Health Information Technology Competencies (HITComp) [10]. There are 1,025 detailed competencies in the HITComp set, mapped to 15 domains. These 15 domains have 4 general categories of Administration, Direct Patient Care, Informatics, and Research/Biomedicine. This is consistent with the study's technology, clinical, and compliance clusters.

Table 2 – Mapping of Clusters to Competencies

Cluster & Focus	IMIA	HIT-Comp	CHIA	COACH	AMIA
1 – technology	XX	XX	XX	XX	XX
2 – clinical	XX	XX	XX	XX	XX
3 – business			x	x	
4 – compliance		XX	XX	XX	

Australasia

The Health Information Management Association of Australia (HIMAA) HIM Competency Standards (3rd edition) has three competency levels, from graduate entry through advanced practitioner [11]. The competencies are set within 9 domains, including clinical, management, terminologies and classifications, compliance, and technology. The Certified Health Informatician Australasia (CHIA) released the first edition of their Certified Health Informatics Competencies Framework in 2013 [12]. The CHIA framework is consistent with the technology, clinical, and compliance clusters, though CHIA includes project management in their management science domain, which is found in the business cluster of this analysis.

Canada

Canada's Health Informatics Association, COACH, has 7 categories of competencies [13]. As with the previous organizations, it includes content relevant to the technology, clinical, and compliance clusters. Consistent with the HIMAA and CHIA frameworks, it includes project management from the business cluster.

United States

The American Medical Informatics Association (AMIA) released a new set of core competencies in 2017 [14]. Very broadly drawn to include a variety of focus areas, the knowledge, skills, and abilities (KSAs) map most clearly to the technology and clinical clusters.
The American Health Information Management Association (AHIMA) also revised their core competencies as part of their HIM Reimagined strategy. The 2018 draft competencies expand capabilities across the areas of data analytics, auditing, and information governance [15].

Conclusions

Overall, the competencies currently articulated for educational programs by IMIA, the HITComp project, and associations in several countries, covers a majority of the terms found in job descriptions; however, sales and marketing are noticeably missing. Health informatics jobs are generally low, possibly due to a lack of standardized job titles in the informatics field.

When looking at the job categories, the majority of jobs are focused on project management, health leadership, and health information technology with fewest on health informatics, health consumer engagement, and clinical documentation improvement. The UK, Canada, Australia, and India have a greater prevalence of data analysis jobs compared with the U.S., which has a high number of consumer engagement, clinical documentation improvement, and information governance jobs. The findings from this study can inform HIIM educational providers about future skill requirements.

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Figure 4 - Heatmap of the prevalence of jobs by category across each country

	Health Informatics	Health Consumer Engagement	Clinical Documentation Improvement	Health Information Governance	Health Data Analysis	Health Compliance	Health Research	Health Information Technology	Health Leadership	Health Project Management	Total Postings
United States	369	410	413	399	378	402	401	420	411	408	4011
United Kingdom	65	139	167	375	311	359	379	413	399	358	2965
Canada	58	89	166	141	303	344	355	418	389	355	2618
Australia	14	56	80	148	263	328	351	410	396	325	2371
India	15	39	47	39	256	277	347	411	361	282	2074
China	12	19	30	17	143	299	342	230	395	320	1807
Ireland	1	19	28	19	85	286	176	251	344	310	1519
Netherlands	24	20	18	17	81	175	280	270	200	308	1393
Germany	20	27	10	11	75	177	350	210	260	245	1385
Singapore	5	18	9	6	77	230	215	175	276	302	1313
South Africa	1	1	1	40	41	265	108	100	310	257	1124
Poland	8	20	10	11	94	112	109	170	174	199	907
United Arab Emirates	0	1	15	7	35	198	100	70	180	202	808
New Zealand	1	1	1	12	23	105	78	90	288	194	793
Philippines	0	1	10	8	48	160	77	129	153	175	761
Hong Kong	6	10	1	8	62	72	132	100	127	232	750
Belgium	0	9	20	11	35	86	109	90	94	231	685
Switzerland	10	1	20	5	33	81	147	70	141	138	646
France	6	10	10	13	24	67	99	120	112	133	594
Romania	38	10	1	0	40	55	65	120	63	182	574
Malaysia	0	9	1	5	31	112	58	70	120	124	530
Nigeria	0	1	1	18	20	74	85	50	124	157	530
Vietnam	0	1	1	0	32	73	82	90	108	101	488
Spain	0	9	9	6	37	48	90	80	82	126	487
Japan	5	9	10	4	25	67	90	60	91	92	453
Thailand	0	1	1	8	23	86	48	50	134	69	420
Italy	1	9	1	6	25	56	56	90	79	68	391
Saudi Arabia	1	1	1	0	18	88	46	60	75	67	357
Mexico	0	1	1	1	22	70	35	60	85	76	351
Qatar	1	0	1	1	12	65	73	60	60	60	333
Denmark	1	9	1	8	17	22	102	50	56	65	331
Indonesia	1	1	1	1	17	49	37	30	97	74	308
Sweden	1	1	1	1	19	31	54	60	54	56	278
Czech Republic	1	1	1	5	16	59	32	70	43	49	277
Portugal	6	0	0	0	16	28	54	70	33	67	274
Hungary	6	0	1	0	16	42	63	40	37	52	257
Brazil	1	1	0	1	15	26	28	50	33	49	204
Egypt	0	1	0	0	10	45	24	30	47	38	195
South Korea	0	1	1	1	5	28	48	30	36	31	181
Ukraine	0	1	1	1	20	12	37	20	28	57	177
Greece	1	0	0	1	21	13	25	50	27	36	174
Austria	1	1	1	1	11	15	37	30	30	30	157
Norway	0	1	1	0	18	16	36	30	21	25	148
Israel	0	1	1	0	8	28	47	20	17	17	139
Argentina	1	1	0	0	6	20	20	30	23	34	135
Russia	0	0	1	1	7	12	25	20	29	34	129
Turkey	0	0	1	1	12	26	24	20	27	18	129
Pakistan	0	1	1	1	12	18	26	17	27	23	126
Kuwait	0	0	1	0	2	26	5	20	38	22	114
Finland	0	1	1	1	10	5	26	40	16	12	112
Taiwan	0	1	0	0	11	12	21	20	25	13	103
Luxembourg	0	1	0	1	5	13	13	20	16	22	91
Costa Rica	1	0	1	0	5	10	18	20	14	17	86
Colombia	1	0	0	1	2	17	17	10	9	12	69
Chile	0	0	0	1	0	8	9	10	17	19	64
Morocco	0	1	0	0	1	14	1	20	8	19	64
Panama	0	0	0	1	2	2	8	10	16	10	49
Oman	0	0	1	0	1	14	1	1	10	13	41
Antarctica	0	0	0	0	0	2	9	1	10	18	40
Bahrain	0	0	0	1	0	9	9	1	9	7	36
Peru	0	0	0	1	0	3	10	1	10	8	33
Ecuador	0	0	0	0	0	9	1	1	1	1	13
Uruguay	0	1	0	0	1	1	1	1	0	0	5
Venezuela	0	0	0	0	0	0	0	1	1	1	3
Total Postings	683	967	1101	1366	2938	5452	5751	5781	6896	7045	**37980**